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Illinois Institute of Technology

September 15, 1997

Dr. Andre M. Van Tilborg, Director
Computer Science Division
Office of Naval Research
Scientific Officer Code 333
Ballston Center Tower One
800 North Quincy Street
Arlington, Virginia 22217-5660

Re: Final Performance Report under Grant Number N00014-94-1-0885 Entitled "Improving the Quality and Impact of DOD Research Through Enhancement of the Computing Infrastructure at Illinois Institute of Technology"

Dear Dr. Van Tilborg:

Illinois Institute of Technology is pleased to submit three copies of the Final Performance Report documenting our progress under the referenced grant. This report covers the three year period of performance, June 1, 1994 through May 31, 1997. The Standard Form 298 is attached to each copy.

As the report indicates, we have achieved the goals defined by 11 integrated project areas encompassed by the grant. This offers direct benefits to the range of research programs and capabilities at IIT focused to the needs of the Department of Defense.

If you have any questions or would be interested in additional information, please let us know.

Respectfully submitted,

Darsh Wasan

Darsh T. Wasan
Vice President of International Affairs and Principal Investigator

cc: Mr. John Chiappe, Administrative Grants Officer (1)
Director, Naval Research Laboratory (1)
Defense Technical Information Center (1)
Professor Rollin Dix, Co-Principal Investigator
Tina Bottini, Office of Research Administration

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE 9/15/97	3. REPORT TYPE AND DATES COVERED Final 6/1/94 - 5/31/97

4. TITLE AND SUBTITLE
Improving the Quality and Impact of DOD Research Through Enhancement of the Computing Infrastructure at Illinois Institute of Technology

5. FUNDING NUMBERS
Grant Number N00014-94-1-0885

6 AUTHORS
Dr. Darsh T. Wasan, Principal Investigator
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Illinois Institute of Technology, 10 W. 33rd Street, Chicago, Illinois 60616

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research
Ballston Center Tower One
800 North Quincy Street
Arlington, VA 22217-5660

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Pubiic Release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report describes the projects developed and implemented with support from Grant Number N00014-94-1-0885 entitled "Improving the Quality and Impact of DOD Research through Enhancement of the Computing Infrastructure at Illinois Institute of Technology." The report covers the period from June 1, 1994 to May 31, 1997.

The three years of this project focused on implementing the plans described in the original proposal and improved by a series of faculty Task Forces during the first year of the project under the supervision of a Steering Committee. Regular meetings of the Steering Committee throughout the grant period resulted in the modifications of a number of decisions to better serve the needs of the university in the face of changing conditions. All of the work performed under this grant is described herein in the eleven key topics of the proposal.

The DOD funding has allowed IIT to implement many new computer related programs, furnish new laboratories with state-of-the-art equipment, substantially upgrade nearly all existing computer laboratories, and ultimately improve curricula. This funding has also provided extensive campus-wide Ethernet hardware and wiring to all buildings, and combined with the other software and hardware acquisitons, this has allowed IIT to dramatically improve computer and network services to on-campus and remote students and faculty and also to increase IIT's presence in community programs and distance learning and research.

14. SUBJECT TERMS

15. NUMBER OF PAGES
13

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

IMPROVING THE QUALITY AND IMPACT OF DOD RESEARCH THROUGH ENHANCEMENT OF THE COMPUTING INFRASTRUCTURE AT ILLINOIS INSTITUTE OF TECHNOLOGY

ONR Grant Number N00014-94-1-0885
Final Performance Report: 6/1/94-5/31/97

Abstract

This report describes the projects developed and implemented with support from Grant Number N00014-94-1-0885 entitled "Improving the Quality and Impact of DOD Research Through Enhancement of the Computing Infrastructure at Illinois Institute of Technology." The report covers the period from June 1, 1994 to May 31, 1997.

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Compatibility Between the Enhanced IIT Computing Infrastructure and DOD Research Areas

The computing infrastructure at IIT, enhanced via the DOD grant, now offers state-of-the-art capabilities that impact our research, education and outreach efforts on a daily basis.

The information research tools that emphasize scientific visualization are being used in a variety of research programs to provide enhanced analytical capability. This is particularly true in the field of fluid dynamics research focused to boundary layer turbulence, digital particle image velocimetry and related areas of investigation. For example, IIT's Fluid Dynamics Research Center applies computer visualization to represent four-dimensional data sets corresponding to measured or computed velocity components in three-dimensional space and time. Visualization is also used to perform solid rendering of coherent features extracted from conditionally-sampled data sets in turbulent flows or those undergoing transition to turbulence. These data sets are large in size so that data visualization is an essential tool to efficiently extract information and present central features.

Other areas of investigation benefit from an enhanced computing capability that is focused to scientific visualization of flow, diffusion and reaction phenomena through animation. This includes study of blood substitutes and study of multiphase flow. Computer techniques include numerical simulations using finite difference, method-of-line and collocation numerical techniques applied to explosives propagation, circulating fluidized beds and pneumatic conveying systems. In a broader sense, IIT's research capabilities in electrical and computer engineering, computer science and applied mathematics, synchrotron sciences, and materials are all deriving benefits from the extensive and powerful computing capabilities now available as a result of the DOD computing grant.

The DOD grant has been instrumental in establishing the hardware, software and core staff support needed to assist faculty in developing lecture and study materials that explore engineering and scientific concepts using visual metaphors that complement the traditional mathematical perspectives. The DOD grant has had similar positive impacts through the creation of workstation clusters, computerized classrooms and lecture halls, and computer technology that enhances the delivery of tutorial services to minority students in communities adjacent to the campus. The following listing of research grants illustrates the nature of on-going activities at IIT that benefit directly from the enhanced computing infrastructure made possible by the DOD grant:

Selected IIT Research Grants & Contracts Awarded During the Period of Performance of the DOD Computing Infrastructure Enhancement Grant

- Active Control and Modeling of Three-Dimensional and Non-Equilibrium External & Turbo Machinery Flows Simulated, AFOSR, Drs. Acharya and Nagib, Mechanical, Materials & Aerospace Engineering
- Smart Sensor Arrays for On-line Detection of Flow Reversal Separation and Transition in Flow Control, Sponsored by NASA, Dr. Acharya, Mechanical, Materials & Aerospace Engineering
- A Collaborative Approach Towards the Development of Turbulence Models for Non-Equilibrium Flows, NSF, Drs. Nagib and Naguib, Mechanical, Materials & Aerospace Engineering
- Development of Minority Institution Fuel Cell/Battery/Manufacturing Research HUB, ARO, Drs. Selman and Smotkin, Chemical & Environmental Engineering
- Development of Computer Visualization Software, Argonne National Laboratory, Dr. Evens, Computer Science & Applied Mathematics
- Investigation of Incipient Dynamic Stall at High Reynolds Numbers, Army, Dr. Acharya, Mechanical, Materials & Aerospace Engineering
- Undergraduate Research at the Fluid Dynamics Research Center, NSF, Dr. Acharya, Mechanical, Materials & Aerospace Engineering
- Digital Particle Image Velocimetry for the National Diagnostic Facility, NSF, Drs. Cardell and Wark, Mechanical, Materials & Aerospace Engineering

- Smart Wall for Control of Burst Cycled of Longitudinal Vortices in Turbulent Boundary Layers, ARO, Dr. Corke, Mechanical, Materials & Aerospace Engineering
- Controlled Experiments on Instabilities and Transition to Turbulence on Cones at Mach 3.5 and 8, NASA, Drs. Corke and Wark, Mechanical, Materials & Aerospace Engineering
- Hysteresis and Acoustic Emission as Non-Destructive Measures of the Fatigue Process in Metals, AFOSR, Drs. Guralnick, Civil Engineering, and Erber, Physics
- PIV Investigation of Turbulent Boundary Layers Subjected to Internally or Externally Imposed Time-Dependent Transverse Shear, ONR, Dr. Nagib, Mechanical, Materials & Aerospace Engineering
- Investigation of the Physics of Screech in Supersonic Jets, AFOSR, Dr. Nagib, Mechanical, Materials & Aerospace Engineering

Specific Computing Infrastructure Enhancements

The accomplishments of the last three years under funding by the DOD grant are outlined below in the eleven specific task areas of the proposal:

1. Research Visualization Center

The Research Visualization Center, located in the Engineering One building, provides the capability for campus researchers to use data processing and visualization software, create color printouts, and generate videotapes and computer-based movies from the images and simulations created by their research. Computer hardware includes a Silicon Graphics, Inc. (SGI) Indigo 2 XZ workstation with a Galileo graphics board, an SGI Indy workstation for programming, and a Tektronix color printer. Software available in these systems includes the SGI Varsity software package (including programming language such as C, C++, and Fortran), PV-Wave, Hypermesh, Abaqus, Mathematica, and other public shareware and freeware requested by the students and faculty. Video equipment includes a Panasonic AGW1-P multiple format video recorder, two Sony EV-S7000 NTSC 8mm video recorders, a JVC AV signal selector, a Sony PVM-1954Q 19" video monitor, and a portable Sony 8mm video player.

This center is managed by Mr. Jeff Beer, who divides his time equally between the center and the Fluid Dynamics Research Center of the Department of Mechanical, Materials, and Aerospace Engineering (MMAE) and the MMAE PC Workstation and CAD/CAM Cluster.

2. Integrated Library System

During the first two years, Galvin Library's projects focused broadly on (i) upgrading access to electronic indexes, abstracts, and full text databases and (ii) expanding accessibility to library materials using the campus network and the Internet.

Two stand-alone CD-ROM workstations were purchased to support full-text imaging materials from IEEE/IEE and business/management databases. The CD-ROM server was

upgraded from seven to twenty-eight drives with six databases, including two for full-text systems: the *Chicago Tribune* and *Selected US Government Documents*. Local Area Network (LAN) wiring has connected staff and public access computers and allowed their access outside the library building.

As a result of the DOD funding, Galvin Library was able to install and initiate new systems that allow students and faculty to use the library's networked resources remotely, via the Internet. IIT library patrons now have 7-day/24-hour remote access to 19 of Galvin's 41 electronic databases.

The Galvin Library World-Wide Web site (http://www.iit.edu/~library) was developed to serve not only as an "online brochure" for the library, but also as a single "launching point" for the full range of the library's remote resources. Besides offering access to telnet-based searchable databases, the web site also introduces the Galvin Library Electronic Reserves Project. Using scanners and Adobe Acrobat software, Galvin staff convert non-copyrighted course reserve materials (usually submitted in paper format) into digital documents that can be retrieved by students via the web site. During the first semester of the project, the electronic reserves site was used over 500 times and its popularity continues to grow. Faculty participation is also expanding, but at a rate slightly less than that of the students.

In addition to allowing the library to extend resources and services remotely, the DOD funding has made possible the improvement of internal systems and services providing a more stable environment for in-library users and easier access to a wider range of databases.

During the 3rd year of the DOD grant the library made a number of purchases relating to the Digital Library project. The majority of funds were used for software. This software package, Voyager, is an integrated library product with 8 modules that integrate functions of the public access catalog, circulation, acquisition/serials, cataloging, notices, reports, system administration and the document image module in one all-inclusive system. The image module alone includes eleven sub-modules that constitute the platform of the digital image library.

At this point, all modules are installed, and the online public access catalog, acquisition, cataloging and serials are functioning. The remaining modules are expected to be fully functioning before the end of 1997.

Also purchased were hardware upgrades (Sun & Compaq) to run the Voyager system and supporting servers as well as clients. These upgrades provided the necessary hardware speed at both the server and workstation levels, and the purchases were completed with a fault tolerant system in mind. The UNIX based servers, for example, are protected with disk arrays, tape back-ups, and un-interruptible power supplies. At the workstation level, all of our public workstations now have are at minimum Pentium class computers with 32 megabytes of RAM.

On the database level, the subscriptions have moved from standalone CD-ROM products to Web-based access. The two most used databases that were converted using this fund were the ABI-Inform of UMI and the Engineering Index of Engineering Information Inc. Today, these databases, along with a host of other subscription services, are available to IIT

students and faculty from any computer on the campus network, and remotely through the dial-in to the IIT network.

3. HPCC Network and Computer Facilities

This initiative has focused on improving the access, speed, and reliability of the campus network and campus computing facilities that are operated by the university's Computing and Network Services (CNS). Figure 1 summarizes these facilities.

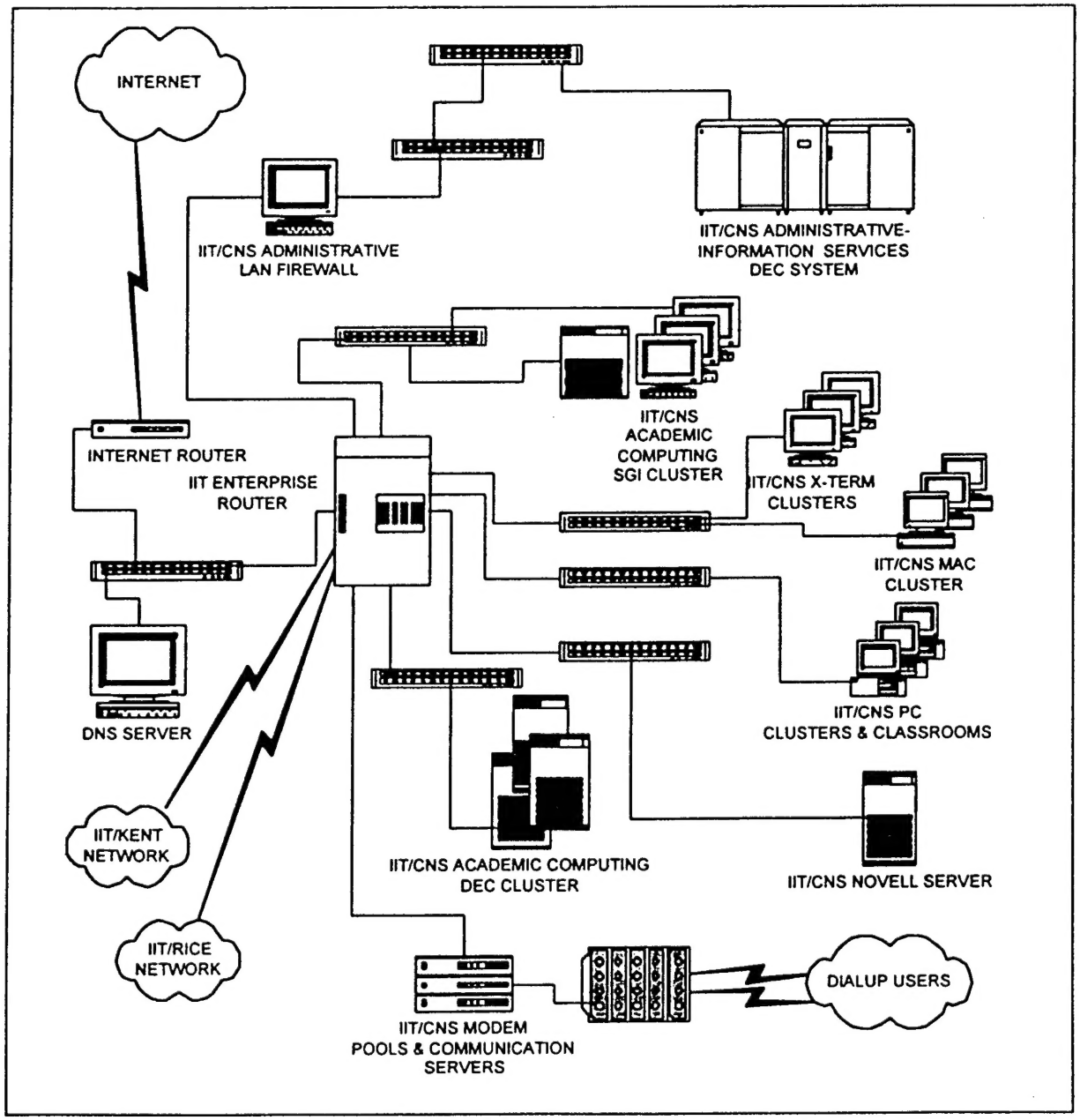

Figure 1 - IIT/CNS Major Computing Resources

The upgraded campus network interconnects campus buildings using a fiber-optic star network centered in the telephone switch room of Perlstein Hall (home of the President's Office) based on a Cisco 7000 router with 24 separate Ethernet subnets. A T1 link connects from here to NetIllinois and onwards to the national Internet. Fractional T1 lines connect the main campus to IIT's Kent downtown campus (law and business school) and to the IIT Rice campus located about 40 miles from downtown Chicago.

In each Main Campus building the fiber connects to one (or two) network Point of Presence (netPOP) cabinets from which twisted pair Ethernet cabling connects to individual classrooms, offices, and laboratories. Recent acquisitions were twenty-seven medium-scale and eight small-scale 10-BaseT SNMP manageable Ethernet Concentrators that were deployed in the past 36 months in the campus administrative buildings, classrooms, fraternities, and dormitories which are summarized in the following.

Fraternities:

Eight small-scale 10Mbps concentrators with potential allowing for up to 72 connections in each house are installed in the eight IIT fraternities, one per fraternity house, with a total of 240 10-BaseT ports.

Residence Halls:

Twelve medium-scale 10Mbps concentrators with potential allowing for up to 96 connections for every two floors of each wing in the Dorms complex. These are installed in six wings, two per wing with a total of 192 10-BaseT ports.

Academic & Administrative Buildings:

These building have the most comprehensive installation of Ethernet connections. Sixteen medium-scale 10Mbps concentrators with potential allowing for up to 192 connections from each concentrator. These are installed across the campus, one, two, or three per building:

Stuart Building - Three; two w/96 10BT ports, and one w/144 10BT ports
Life Sciences Building - Two w/48 10BT ports each
Engineering One Building - Two; one w/192 10BT ports, one w/120 ports
Alumni Memorial Building - One w/48 10BT ports
Perlstein Hall - Two w/96 10BT ports each
Wishnick Hall - One w/48 10BT ports
Siegel Hall - One w/192 10BT ports
Galvin Library - One w/72 10BT ports
Crown Hall - One w/120 10BT ports
IITRI Building - ID Department - One w/24 10BT ports
Farr Hall - One w/24 10BT ports

It is estimated that 85% of the active ports in academic and administrative buildings are serving customers. In the dorms, 185 students were served during the 96/97 school year, and in the fraternities, 55 students were served during the 96/97 school year.

To support the network operation CNS operates a Sun Domain Name Server, a Cabletron LanManager microcomputer, a portable Network General sniffer, and a cable scanner. Firewall and Kerberos security systems have now been installed. The Kerberos system regulates access to the campus modem pool by requiring that each user have a login on the primary CNS server (charlie.cns.iit.edu) and have a separate Kerberos password to complete the dialup or PPP connection.

CNS provides the university community with a number of publicly accessible computer systems, several PC clusters, a Netframe Novell Server, a cluster of DEC Vaxes, a cluster of SGI computers, and a cluster of Xterminals which are used to access Vax, SGI, and departmental Unix systems.

The SGI cluster is centered around "Charlie" (charlie.cns.iit.edu) , an SGI Challenge L purchased with DOD funds. Charlie features eight 200Mhz MIPS R4400 processors, 512Mb of memory and 40 Gb of disk space. Additional SGI Indy workstations ("Linus", "Lucy", etc.) are also part of this cluster. This cluster currently supports over 4,900 faculty and student computer accounts, and this number continues to grow. Software available on this cluster to support education and research includes the SGI Varsity software (Fortran, C, C++, etc.), Mathematica, Matlab, ABAQUS, FIDAP, and SAS. This system also supports IIT's main Web server.

Access to this network is provided through connections to CNS computer systems, departmental and administrative computer systems, and approximately 80 dial-in ports which operate at speeds of up to 28.8 Kbps.

4. Workstation Clusters and Software

Six workstation clusters have now been purchased and installed. The first "cluster" was actually a group of Unix workstations that were distributed among the various academic units at IIT. All of the other clusters were planned renovations to classrooms and laboratory spaces. The clusters were installed into several buildings and are managed by the local academic units.

As mentioned previously, the first cluster was distributed between the departments of Biological, Chemical and Physical Sciences (BCPS), Chemical and Environmental Engineering (CHEE), Civil and Architectural Engineering (CAE), Computer Science and Applied Mathematics (CSAM), Electrical and Computer Engineering (ECE), and Mechanical, Materials, and Aerospace Engineering (MMAE). Workstations of various manufacturers (SGI, HP, Sun) were purchased based on the needs of the individual departments. These workstations were disbursed to have an immediate campus-wide impact. Some of these workstations were later integrated into fixed laboratories as rooms were renovated and new Ethernet connections installed.

The second workstation cluster is located in the Engineering One building adjacent to the Research Visualization Center described previously. This cluster features eight SGI Indy workstations; software available in this cluster includes the SGI Varsity languages (including Fortran, C, C++, etc.), Mathematica, PV-Wave, IMSL mathematical subroutines, and Pro/ENGINEER CAD software. This cluster is maintained by the Department of Mechanical, Materials, and Aerospace Engineering.

The third workstation cluster is located in the Stuart building and features SGI workstations; software available on this cluster includes the SGI Varsity languages (including Fortran, C, C++, etc.). This cluster is maintained by the Department of Computer Science and Applied Mathematics (CSAM). DOD funds were combined with department funds to purchase a total of 8 SGI Indy workstations and 2 SGI Indigo2 workstations. Half of these machines are in an open-access laboratory for use by

undergraduate and graduate students in research and education. The other half are in a limited-access laboratory for research use only.

The fourth workstation cluster is located in Perlstein Hall and features four Hewlett-Packard workstations and a server; software available on this cluster includes HP compilers (Fortran, C, etc.), the Flow-3D analysis package, and other packages that provide computational capabilities for Chemical and Environmental Engineering research.

The Siegel Hall Workstation Cluster (workstation cluster number five) is located in Siegel Hall room 333. DOD funds were used to purchase 8 Sun Ultra 1 Model 140 workstations, one Sun Ultra 2 Model 2200 dual-processor workstation, and a stacking DAT tape drive to support backups. This equipment greatly extended the existing cluster, which was based on older and slower Sun SparcStation LX workstations.

Software available on the Siegel Hall Workstation Cluster cluster includes several compilers (C, C++, Fortran, and Java) to support general-purpose programming, MATLAB to support communications, digital signal processing, and image processing research and education, OPNET to support computer network research and education, and a set of commercial (Synopsys) and public domain (Magic, OctTools) CAD tools to support VLSI design and VLSI CAD research and education. This cluster is maintained by the Department of Electrical and Computer Engineering.

The Department of Biological, Chemical and Physical Sciences has established a High Performance Computing Laboratory (the sixth cluster) in the Life Sciences Building. The laboratory is being used for basic and applied research by BCPS faculty and students in a wide spectrum of areas including computational biophysics, complex systems, and high temperature superconductivity. The cluster will also be used in senior year and graduate level teaching, starting in the 1997/98 academic year and provides a basis for for interdisciplinary computational science degree programs which merge elements of computational biophysics, quantum chemistry, and computational physics.

The BCPS laboratory is located in room 091 in the basement of the Life Sciences Building, and it is equipped with a cluster of 7 Silicon Graphics O2 workstations, a Silicon Graphics Origin 200 server, 5 NCD 20-inch X-Terminals, a Hewlett Packard Postscript printer, 2 Pentium Pro PC's with scanner, and a Hewlett Packard Color DeskJet printer and a tape backup system. The inclusion of the Pentium Pro PC's with a scanner and a color inkjet printer allows faculty and students to prepare color visuals for lectures and demonstrations, based on computational work done on the cluster.

The Origin 200 server is also configured as a web server and will be used, starting in the 1997/98 academic year, to provide on-line access to laboratory manuals and laboratory demonstrations over the world wide web to all undergraduates in the General Physics laboratory courses. The cluster will also be used by senior year undergraduates and graduate students enrolled in the PHYS 440 Computational Physics course in Spring 1998, as well as by senior year undergraduates in PHYS 491/497 special projects courses starting in Fall 1997.

5. Argonne National Laboratory Collaboration

As submitted and approved in the budgeting process in the summer of 1994, the scale of support for collaboration with Argonne's High Performance Computing Research facility was reduced. Other collaborations between IIT and Argonne are underway and primarily involve the Advanced Photon Source project.

The funds from this reduction were used for the purchase of the "Charlie" SGI Challenge L system described in Section 3.

6. Instructional Innovation and Multimedia Center

This center provides faculty assistance and training with lecture and classroom use of multimedia. Facilities in this laboratory include four networked Pentium personal computers, a color scanner, a color printer, a laser printer, a scan converter to convert graphical output to NTSC video, a video frame grabber for still frame video capture, and a VHS VCR to record presentations. A range of multimedia software has been purchased for training faculty in creating instructional presentations.

The major activities of this center include:

- Conducting training sessions for faculty and staff in the use of multimedia products, the development of multimedia presentations, and the use of the Web both as a communications tool and as a means for presenting innovative course materials. Approximately 80 of these training sessions were scheduled during the 1995/96 and 1996/97 academic years.
- Working one-on-one with faculty on the development of multimedia- and Web-based course materials.
- Providing a technical support resource for faculty regarding the purchase, installation, and use of multimedia hardware and software. This support is provided in one-on-one interactions with faculty and also through a Web page (http://www.iit.edu/~imc) that is used to disseminate information about instructional use of Multimedia software and the Web.

A QuickStart Fund was established to provide faculty groups with software, hardware or student programming support to introduce multimedia and computer tools in instruction. Over 30 faculty received grants to fund enhancement of courses in engineering, the sciences, architecture and business. A review of these efforts was held in November 1995 and allowed faculty to exchange information about their experiences.

A new initiative was developed to introduce portable (laptop) computers to faculty and students for course instruction in the Fall of 1996. To support this initiative, 12 Dell Latitude LM Pentium portable computers were purchased for curriculum development and multimedia based instruction using the LCD projectors that are now available across the campus. These computers were assigned to academic departments across the campus, and each computer is shared by several faculty members for use in undergraduate teaching. Network connections are available in all auditoriums and classrooms, making it possible to display the results of remote computations during a class or seminar.

7. Computer Classrooms and Software

All of the existing CNS computer laboratories were upgraded over the past three years, and these upgrades to the PC instructional labs were done in two phases. Phase I was done in the first year of the DOD grant. The work included 1) upgrading of a portion of the machines in 112F (Stuart Building), 112E (Stuart Building), 261 (Engineering One) and the Galvin Library to Pentium-based 90MHz for stand alone use and use with the Novell server, and 2) adding several 486DX4 100 MHz machines to lab 261 (Engineering One) to bring the capacity of each lab to be able to accommodate 20 students in accordance with the new standard for our instructional labs.

Also in the first year, memory, hard disks, and processors were upgraded in all primary PC classrooms, including facilities in Stuart Building, Engineering One, Galvin Library, the Residence Halls and Fraternities. Network cards in all PC classrooms were replaced with 10-BaseT cards, and all network wiring was replaced with Category 5 twisted-pair cable.

Printing in PC classrooms has been supported through the purchase of two HP Laserjet 5 Si printers for the Stuart Building computer classrooms, and Laserjet 4Si laser printers for classrooms in Galvin Library and Engineering One.

A Netframe Novell server was purchased during the first year to provide software access and student file storage accounts. During the second year, this server has been upgraded with additional memory and 10 Gb of disk space to meet increasing student demands.

Phase II was done in the third year of the DOD grant and included Room 112F (Stuart Building) and one lab in the dorms. The total number of machines upgraded were 18 in Room 112F (Stuart Building) and 20 in the dorms, and each was upgraded to a Pentium 133 MHz with 512 cache, and 32 MB RAM, 2MB VRAM, CD ROM.

Licenses for a range of software items were purchased for use in computer classrooms, including operating systems (MS Windows), word processing/productivity packages (MS Office, Framemaker, ZMail), compilers for several different programming languages (SGI Varsity compiler package, MS Fortran, Watcom77), tools for mathematical analysis (MATLAB, Mathematica, IMSL, SPSS, Daedelus), mechanical Computer-Aided Design (CAD) and analysis (Pro/E, Pro/Jr, Fidap, ABAQUS), electronic CAD (Synopsys), visualization (PV-WAVE), and computer network analysis (OpNet). This software has been used extensively in courses ranging from introductory Freshman courses to advanced graduate courses.

Funding from the DOD grant was used to outfit a new Computational Mathematics Laboratory with thirty networked Pentium workstations. Creation of this facility was a pivotal step in our effort to incorporate mathematics software as an integral element in the undergraduate mathematics curriculum. Using Maple software, these machines allow students to solve mathematical problems using symbolic programming so that students can vary parameters and investigate concepts that were not possible through conventional pencil-and-paper homework assignments.

A cluster of Dell 166 MHz WindowsNT personal computers and a HP LaserJet 5 postscript printer were installed in Room 216 of the Engineering One in the Fall of 1996. This cluster contains thirteen NT workstations and a server all with SCSI Zip drives. It is used

with PTC's PT/Modeler (CAD/CAM) software for instruction and laboratory exercises for undergraduate and graduate students in the MMAE Department. Additional software available on these workstations also includes Microsoft Office, HyperMesh, AutoCad, and Internet software.

Similar to the Engineering One cluster, the College of Architecture was the recipient of thirteen WindowsNT personal computers with SCSI Zip drives. These computers were setup in Room One of Crown Hall in the same workstation/server configuration as those in the Engineering One building. Additionally, two HP LaserJet 4MV 11"x17" printers are available in this room. These machines (along with several other PC's and Macintoshes supplied by the College of Architecture) are used for undergraduate education and research with the primary functions of CAD, graphics manipulation, rendering, and web browsing. The software installed in this laboratory includes Microsoft Office, AutoCad, 3DS, FormZ, Microstation, and Internet software.

In addition to these computer clusters, several campus-wide software licenses were also obtained. Specifically, licenses for AutoCad and Maple were obtained primarily for instruction in the CAE, Architecture, and CSAM departments although access to the software is not limited to these departments. The AutoCad license included 100 hardware locks for distributions throughout campus, while the Maple software was chosen to teach symbolic computer math to freshman and sophomores to be utilized in advanced junior and senior level courses.

8. Interactive Multimedia Classrooms

The term "interactive multimedia" is used to signify that both the students and instructor can simultaneously distribute textual, graphical or other computer generated media in an integrated environment. A multimedia classroom has been implemented by the Department of Chemical and Environmental Engineering that features 16 Pentium personal computers running Windows NT with in-desk monitors, an instructor's console that includes a computer and can control the displays of the student computers, video equipment, and a ceiling-mounted video projector.

In a second classroom, thirty personal computers and a multiprocessor Compaq Citrix server were purchased to support the interactive Student Writing Center in Siegel Hall under the direction of the Department of Humanities. This classroom features six horseshoe-shaped desks with five computers each and a printer for each of the desks. Each computer has a hard disk drive and access to the server so that applications can be run locally or from the server. The Writing Center software includes Microsoft Office, Daedelus collaboration software, and Internet software. The Citrix software also allows remote server access to other machines on the campus network.

9. Computer-Based Lecture Rooms

Ceiling-mounted projectors have been installed in three major lecture halls (Engineering One, Stuart Building, Perlstein Hall) in conjunction with improvements to IITV (see Section 11), allowing the display of output from a computer, VCR, or document camera. Two of these classrooms also act as IITV studios; in these classrooms the computer, VCR,

or document camera output can be simultaneously displayed by the projector and broadcast to remote students via IITV.

Four portable General Electric and one Hitachi VGA/video projectors have been purchased for use in lecture rooms around campus. These projectors have been distributed to different locations on campus so that they can easily be checked out and used for lectures with a laptop personal computer.

10. Multimedia in Outreach

A number of existing outreach programs were identified for support in this effort, which provides programs, technology, and support to the community, including local schools and community organizations. Two laptop computers were purchased to support these programs. A laptop computer was purchased to support the SMILE (Science and Mathematics Initiative for Learning Enhancement) program for improving the teaching skills of local Science and Mathematics teachers. Over 200 teachers participate in this program each year.

A personal computer was purchased to support the Pilsen/Little Village Habitat for Humanity organization to rehabilitate housing units for low-income residents of Chicago. This computer is being used to track construction and manage budgets. The rehabilitation of a two-family housing unit is underway and a Co-director of this DOD Grant has joined the Habitat Board as Chairman for Fundraising.

The Educational Technology Center (ETC) also provides multimedia resources for IIT students and area high school and junior high students. Recent acquisitions under DOD funding have been for four X-terminals, a Macintosh 8500 and a Macintosh 8100 with scanner and VideoVision animation hardware. Additionally, two Sony Hi-8 video recorders and an Apple Color LaserWriter 12/600 were purchased for output and presentations. The outreach programs through ETC include DASH, EarlyID, and Bridge which are designed to introduce pre-college students to science and technology in a university environment.

11. IITV Distance Learning Network Growth

The William F. Finkl Instructional Television (IITV) network broadcasts classes to 30 remote sites in the Chicago area via 8 microwave channels. DOD funds were used to upgrade four black and white studios to color and to support multimedia in the course delivery. Two of the studios are large auditoriums and many of the 100 courses taught via IITV each semester originate from these facilities. Ceiling mounted projectors (See Section 7) are integrated with instructor or technical director-controlled podiums, and support the display from a personal computer, document camera, VCR, or other device to the on-site audience while allowing simultaneous broadcast over IITV. This upgrade is dramatically changing the quality and content of lecture materials for both on-site and remote students.

IITV has expanded its delivery technologies to include on-demand delivery of programs and courses via the Internet. DOD funds were used for the purchase of a non-linear editing system. Live classes are taped and media extracted from tape for use as graphics in a s

reamed audio/video delivery system. The first class was available in spring 1997 and was well received by students in 5 different states. This has been expanded to four scheduled for the fall 1997 semester and will continue to grow in the fall semester. The advantages of this delivery paradigm are to provide a high quality educational experience for both students in Chicago and at far remote locations whose employment demands flexible, on-demand education and re-education.